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The major hypothesis of this study (based on the psychology of Clark Hull) was that the learning of a perceptual-motor act from films will be more effective as the film presentation approaches an exact representation of the learner himself performing the act to be learned. The problem was to discover the most effective way to represent the learner in such a film. In films used to teach 3500 Navy recruits the camera angle was either 180[(as if facing someone performing the act) or 0[("over the shoulder" of the learner). Other variables tested included motion pictures versus static, sequential presentations, inclusion of the learner's hands versus their exclusion, and practice. It was found that the more realistic presentations--motion pictures from the learner's perspective--were more effective. Excluding the learner's hands was superior to including them in static presentations. Results from participating during the learning by practicing were not conclusive. (BB)

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EFFECTS OF LEARNER REPRESENTATION IN FILM-MEDIATED PERCEPTUAL-MOTOR LEARNING

(Rapid Mass Learning)

Pennsylvania State College
Instructional Film Research Program
December 15, 1949

Project Designation NR-781-005
Contract N6onr-269, T.O. VII
SDC Human Engineering Project 20-E-4

SPECIAL DEVICES CENTER
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FOREWORD

A BASIC PROBLEM ARISES DURING THE PROCESSES OF BOTH INSTRUCTING AND LEARNING PERCEPTUAL-MOTOR SKILLS AS A RESULT OF THE FACT THAT LEARNING SITUATIONS AND INSTRUCTIONAL MATERIALS DIFFER FROM THE ACTUAL OR REALISTIC PERFORMANCE SITUATION. WORK IN THE CLASSROOM IS OFTEN A CRUDE REPRESENTATION OF WORK ON THE JOB. THE INSTRUCTION USUALLY PRESENTS THE LEARNER WITH ABSTRACT AND SYMBOLIC REPRESENTATIONS OF THE TASKS AND SKILLS TO BE LEARNED. STATED SIMPLY, THE PROBLEM IS ONE OF INVESTIGATING THOSE FACTORS AND CONDITIONS WHICH YIELD POSITIVE, OR NEGATIVE, TRANSFER OF LEARNING FROM THE TRAINING TO THE PERFORMING SITUATIONS.

THIS PROBLEM IS ESPECIALLY PERTINENT TO RESEARCH ON FILM-MEDIATED LEARNING. THE SOUND MOTION PICTURE, HOWEVER, IS A VERY SUITABLE MEDIUM FOR INVESTIGATING THE CONTRIBUTIONS OF DEGREES OF REALISM IN THE REPRESENTATION OF TRAINING TASKS. THE POSSIBLE RANGE OF EXPERIMENTAL VARIATIONS IS WIDE AND MAY INCLUDE VERBAL SYMBOLS, SCHEMATIC ANIMATION (SIGNS), VARYING DEGREES OF PHOTOGRAPHIC REALISM AS WELL AS VARIOUS DEGREES OF AUTHENTIC SOUND. THESE AND MANY OTHER VARIABLES ON THE CONTINUA OF REALISM CAN BE BUILT INTO SOUND MOTION PICTURES FOR EXPERIMENTAL PURPOSES.

DR. ROSHAL HAS MADE AN IMPORTANT EXPLORATORY STUDY OF SOME DEGREES AND KINDS OF REALISM IN SOUND FILM MEDIATED LEARNING OF A PERCEPTUAL-MOTOR SKILL. IT HAS BEEN CLEARLY DEMONSTATED BY THIS STUDY THAT WHEN A TASK TO BE LEARNED IS PRESENTED TO SUBJECTS (TRAINEES) ON THE SCREEN FROM THE VIEWPOINT OF THE LEARNER PERFORMING THE TASK MORE LEARNING GAINS RESULT THAN WHEN THE TASK IS PRESENTED ON THE SCREEN FROM THE POINT OF VIEW OF SUBJECTS WATCHING A DEMONSTRATOR. ALSO, IT HAS BEEN SHOWN THAT THE USE OF ACTION OR "MOTION" IN TRAINING FILMS RESULTS IN IMPORTANT LEARNING GAINS OVER THE REPRESENTATION OF THE TASK IN STILL OR STATIC FORM. OTHER VARIABLES STUDIED, AS DR. ROSHAL WILL SHOW IN THIS REPORT, DO NOT YIELD AS CLEARCUT RESULTS AS THE VARIABLES OF ANGLE OF VIEW AND MOTION.

DR. ROSHAL HAS ATTACKED THE PROBLEMS SELECTED FOR STUDY WITHIN THE CONCEPTUAL FRAMEWORK OF A PARTICULAR LEARNING THEORY. DIFFERENT THEORIES MAY HAVE AFFORDED AN EQUALLY EFFECTIVE CONTENT FOR THE ACTUAL EXPERIMENTAL WORK, OR INDEED, THE RESEARCH MIGHT HAVE BEEN DONE ON A "PRACTICAL PROBLEM" OR "OPERATIONAL" BASIS WITHOUT ELABORATING THEORIES AND POSTULATES. HOWEVER, THE APPROACH FROM THEORY TO PRACTICAL PROBLEMS MAY AID IN THE DIFFICULT LOGICAL PROCESSES OF GENERALIZING TO OTHER TRAINING SITUATIONS, OTHER INSTRUCTING-LEARNING VARIABLES, AND OTHER KINDS OF FILMS. IT IS SUGGESTED THAT, ESPECIALLY IN INSTRUCTIONAL AND INFORMATIONAL FILMS AS WELL AS IN RADIO AND TELEVISION PROGRAMS, THEORY-ORIENTED EXPERIMENTATION IS CURRENTLY MOST IMPORTANT AND URGENTLY NEEDED.

THIS RESEARCH PROJECT, IT IS CONFIDENTLY BELIEVED, WILL LONG STAND AS ONE TYPE OF MODEL FOR EXPERIMENTAL INVESTIGATIONS OF INSTRUCTIONAL COMMUNICATIONS. THE EXPERIMENTAL

DESIGN EMPLOYED AND THE STATISTICAL PROCEDURES USED ARE ESPECIALLY TO BE RECOMMENDED TO OTHER INVESTIGATORS IN THIS FIELD.

THE FILMS PRODUCED FOR THIS RESEARCH PROJECT HAVE CERTAIN LIMITATIONS: IN ORDER TO AVOID USING A TRAINING TASK WHICH MOST SUBJECTS WOULD LEARN COMPLETELY, THE FILMS WERE MADE WITH RATHER RAPID PACING AND WITHOUT REPETITION. CONSEQUENTLY THE FILMS PROVED TO BE TOO DIFFICULT FOR THE MAJORITY OF THE NAVAL TRAINEES. THIS LEVEL OF DIFFICULTY WAS NOT UNINTENTIONAL. HOWEVER, THE EXPERIMENT ITSELF MIGHT HAVE BEEN IMPROVED IF IT HAD BEEN MADE POSSIBLE FOR LARGER PERCENTAGES OF THE SUBJECTS TO LEARN THE TASK. PRE-PRODUCTION TESTS, OR TESTS OF THE FILMS BEFORE FINAL EDITING, MIGHT HAVE REVEALED THIS PROBLEM. ALSO, SUCH TESTS WOULD PROBABLY HAVE SHOWN THE DIFFICULTIES OF THE "PARTICIPATION" REQUIREMENTS, AS WELL AS THE CONFUSIONS INTRODUCED IN THE VISUAL PERCEPTUAL FIELD BY LAP DISSOLVES IN THE STATIC VERSIONS SHOWING THE DEMONSTRATOR'S HANDS. THIS CONSIDERATION EMPHASIZES THE GENERAL PROBLEM IN SOUND FILM RESEARCH OF CLEARLY DEFINING EXPERIMENTAL REQUIREMENTS AND OF ACHIEVING THE BUILDING OF THESE INTO VERSIONS OF FILMS FOR RESEARCH PURPOSES. DRY RUNS, PILOT EXPERIMENTS AND PRE-PRODUCTION TESTING ARE STRONGLY RECOMMENDED.

AS IS THE CASE WITH MOST RESEARCH, COMPLETE FINAL ANSWERS HAVE NOT BEEN FOUND. MORE PROBLEMS HAVE BEEN RAISED WHICH CHALLENGE FUTURE RESEARCH THAN HAVE BEEN SOLVED. NO ULTIMATE PRODUCTION OR UTILIZATION FORMULAS HAVE BEEN DISCOVERED. HOWEVER, THE FINDINGS DO AFFORD SOME DEFINITE CLEAR-CUT RECOMMENDATIONS AS TO PRODUCTION PRACTICE, AS WELL AS ONE OR TWO SECONDARY LEADS THAT MERIT CLOSER STUDY.

DR. ROSHAL CONDUCTED THIS EXPERIMENT FOR A DISSERTATION SUBMITTED AS PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN PSYCHOLOGY. THE PRESENT REPORT IS AN ABRIDGEMENT OF THE DISSERTATION, WHICH INCLUDED ALL THE TABLES OF BASIC DATA AND STATISTICS. THE COMPLETE DISSERTATION IS AVAILABLE ON MICROFILM.

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SUMMARY

Introduction

The principal hypothesis of this experiment is that the effectiveness of a training film designed to teach a skill is increased as the film approaches absolute realism in presenting the task or skill.

The Variables and Film Versions

Eight experimental versions of a film were designed and produced to teach Navy recruits the tying of three knots of graduated difficulty: the bowline, the sheetbend, and the Spanish bowline. These versions differed with respect to four variables which were controlled so as to vary the degree of "realism" achieved in each film version.

The variables employed were:

Camera angles. The tasks were photographed (a) from the viewpoint of the learner facing the demonstrator (180 degree angle), and (b) from the viewpoint of the learner as he would perform the task himself, by shooting over the shoulder of the demonstrator (0 degree angle). In six versions the 0 degree angle was used; in two versions the 180 degree angle was used.

Motion. Four experimental film versions showed the tying of the knots in normal realistic motion or action patterns, (motion versions), and the other four showed progressive steps in the knot-tying sequence, without including the motions (static versions).

Hands. Two of the static versions were produced to include the hands of the knot-tyer; the other two static versions show only the line in successive positions as it was tied. All the motion versions included the demonstrator's hands.

Participation. Four of the versions, each including a unique combination of the preceding variables, required the learners to tie the knots simulatneously with the film demonstration. The other four versions, parallel to the first four with respect to the previous variables, did not require participation during the film showing.

Prodedures

The experimental films were shown to Navy recruits at the Great Lakes Naval Training Center, Great Lakes, Illinois, during November 1948. The films were shown as a part of their regular instruction, and under instructional conditions obtaining at the Center.

EACH VERSION WAS SYSTEMATICALLY PAIRED WITH EACH OTHER VERSION. THE MEMBERS OF EACH PAIR OF FILMS WERE PRESENTED RESPECTIVELY TO HALVES OF SEVEN COMPANIES OF RECRUITS SELECTED AT RANDOM. IN ALL, EACH VERSION WAS PRESENTED TO ABOUT 400 MEN; THE TOTAL SAMPLE COMPRISED APPROXIMATELY 3500 RECRUITS.

SINCE THE THREE DEMONSTRATIONS OF HOW TO TIE EACH KIND OF KNOT FOLLOWED ONE ANOTHER IN EACH VERSION, THE PROJECTOR WAS STOPPED AFTER EACH KNOT WAS SHOWN, AND THE MEN WERE TESTED BY BEING ASKED TO TIE THE KNOT USING A PREPARED LINE.

IN ADDITION, TWO HALF-COMPANIES WERE GIVEN THE TESTS WITHOUT ANY FILM INSTRUCTION IN KNOT TYING.

RESULTS

FOLLOWING ARE THE MOST SIGNIFICANT RESULTS:

1. LEARNING FROM THE FILMS. THE FILMS TAUGHT THE RECRUITS, WITH VARYING DEGREES OF EFFECTIVENESS, HOW TO TIE THE KNOTS. IN THE "NO FILM" GROUP ONLY 7 PER CENT OF THE MEN COULD TIE THE BOWLINE, 3 PER CENT THE SHEETBEND, AND NONE THE SPANISH BOWLINE; MUCH HIGHER PERCENTAGES OF THE EXPERIMENTAL FILM GROUPS SUCCEEDED IN TYING THE KNOTS.

2. DIFFICULTY OF THE KNOTS. THE THREE KNOT-TYING TASKS WERE OF VARYING DIFFICULTY. THE OVER-ALL ORDER WAS, FROM EASIEST TO MOST DIFFICULT, THE BOWLINE, SHEETBEND, AND SPANISH BOWLINE.

3. CAMERA ANGLE. LARGE AND CONSISTENT DIFFERENCES FAVORING THE 0 DEGREE CAMERA ANGLE (THE SUBJECTIVE OR PERFORMER'S EYE VIEW) WERE FOUND FOR ALL THREE KNOTS.

4. MOTION. THE VERSIONS PORTRAYING THE TASK IN CONTINUOUS MOTION WERE SIGNIFICANTLY MORE EFFECTIVE THAN THE STATIC VERSIONS.

5. HANDS. COMPARISON OF THE STATIC HANDS VERSIONS WITH THE STATIC NO HANDS VERSIONS, FAVORS THE NO HANDS VERSIONS. THIS UNEXPECTED RESULT MAY BE ATTRIBUTABLE TO THE FACT THAT THE INCLUSION OF THE HANDS OBSCURED SOME OF THE LINE, AND PRESENTED A MORE CROWDED PERCEPTUAL FIELD.

6. PARTICIPATION. ACCORDING TO THE MAIN HYPOTHESIS IT WAS EXPECTED THAT PARTICIPATION OF SUBJECTS BY ACTUALLY HAVING A LINE IN HAND AND TYING A KNOT SIMULTANEOUSLY WITH THE SOUND FILM INSTRUCTION ON HOW TO TIE THE KNOT, WOULD IMPROVE LEARNING. THIS WAS NOT FOUND TO BE TRUE. THIS OUTCOME MAY BE DUE TO THE FACT THAT THE PARTICIPATION AS DEFINED WAS NOT ACTUALLY ACHIEVED. WHILE ALL SUBJECTS ATTEMPTED TO "PARTICIPATE" A PROPORTION NEVER ACTUALLY SUCCEEDED IN TYING KNOTS. TESTS SHOWED THAT ONLY A FEW MORE KNOTS WERE TIED DURING PARTICIPATION TRIALS WHILE THE FILM SET THE PATTERN AND INSTRUCTIONS WERE GIVEN IN THE COMMENTARY, THAN WERE TIED DURING THE CRITICAL TEST PERIOD

IMMEDIATELY FOLLOWING FILM INSTRUCTION.

Conclusions and Recommendations

1. A film will be more effective in teaching a skill if the task is portrayed from the viewing angle of the learner as he will perform the act. The "subjective" or 0 degree camera angle is more effective than the "observer" or 180 degree camera angle. Directors might well improve the effectiveness of films designed to teach perceptual-motor tasks by taking this finding into account when filming demonstrations of such tasks.

2. A presentation which shows the motions involved is more effective in achieving learning of perceptual-motor tasks involving continuous movement, than a series of static photographs.

3. Further research is needed to determine how participation (in the sense of practice during film showings) can be achieved effectively in training films, and to discover what contribution different kinds and amounts of participation can make to learning.

EFFECTS OF LEARNER REPRESENTATION IN FILM-MEDIATED PERCEPTUAL-MOTOR LEARNING

BY

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I. RATIONALE OF THE EXPERIMENT

It has been demonstrated beyond question that the sound film may be successfully employed to facilitate learning the performance of a perceptual-motor task. Studies by Hollis (2), Lockhart (8), McClusky and McClusky (10), Rolfe (12), and VanderMeer (13) have indicated that films may make significant contributions to the acquisition of such varied skills as cooking, bowling, mat weaving, and engine-lathe operating. Two more recent studies by Jaspen (6) and Zuckerman (15) have studied variables of script organization and production techniques more explicitly than is generally characteristic of research in this area. Jaspen, working with an assembly task, studied such variables as the use of repetition, technical nomenclature, and showing errors to be avoided, etc. Zuckerman, whose study followed in part from the one being reported here, concerned himself with characteristics of the commentary on the sound track. In both these studies it was made apparent that the effectiveness of a film designed to teach a perceptual-motor skill is in large measure a function of the characteristics of the script organization and the production techniques employed.

This report constitutes an exploration of yet another area of film construction, namely, that of the representation of the learning task. Various degrees of representation have been achieved by varying both the visuals in the film, and the film utilization situation itself. Briefly stated, it is the principal hypothesis of this experiment that <u>film-mediated perceptual-motor learning will be facilitated as the learning situation approaches an accurate representation of the learner himself actually performing the task or skill to be learned</u>.

Derivation of the Major Hypothesis

If research in training films is to be more than a collection of empirical data, the rationale and design of such research must proceed from and be assimilated with the main body of learning theory. It is possible to develop hypotheses about film-mediated learning from basic assumptions having more general theoretical implications. Those used here are similar to ones used and elaborated in Clark Hull's behavior theory.

To promote the clarity of the ensuing argument, it is desirable to state rigorous definitions of the terms to be used. The critical terms involved are: stimulus, response, perceptual-motor act, response-strength, and learning. The following meanings will be adhered to throughout this paper:

Stimulus is understood to mean any object or event-complex which occasions an alteration in behavior. This usage does not imply simplicity or singularity of environmental detail. The singular form, stimulus, is defined to include the total situation which occasions the response. The plural form, stimuli, refers to repeated presentations of such a complex, or to more than one of such complexes; not details of the complex. Neither is it claimed that the stimulus necessarily elicits the response. It may simply serve to indicate the occasion for the response. Certain aspects of the stimulus may, however, be more important than others.

Response will denote any stimulus-occasioned act. Whether or not there are or can be acts which are not stimulus-evoked is irrelevant here. The learning dealt with in this research requires a given response on the occurence of a given stimulus.

Perceptual-motor act refers to the overt moving or manipulation of some body part in response to a stimulus. Thus, the following of a moving object with the hand in a pursuit task and the placing of an object in a specified position are examples of perceptual-motor acts.

Response-strength is used here to mean the probability of occurence of a response. It is measured in terms of the number of responses made.

Learning implies the change in strength of a response to a stimulus in consequence of responding to the stimulus. It is recognized that response strength may also change for other reasons. It might prove fruitful to examine these variables in the context of instructional films. However, the present paper is concerned with learning as defined.

Unless it is desired to set up a response to the film itself, the film cannot be considered to present the actual stimulus to which a response is desired. Further, it is highly unlikely that the stimuli presented in the film will specifically evoke the desired response or responses. If this be so, it is necessary to make certain assumptions concerning what happens in film-mediated learning in order to account for the occurrence of any of the intended learning.

First, it is necessary to assume that there is some transfer from the film presented stimulus used in training; that is, that the learning of a response to one stimulus will have some effect on the response to other stimuli.

Second, it must be assumed that during the viewing of the film the learner does in some way respond to the film presented stimuli. He may actually perform the desired responses overtly; he may make the responses implicitly; or, he may make the responses symbolically by verbalization or other self-signalling devices.

Third, if the actual desired response is not performed, it must be assumed that there is some transfer from the response which occurred in the training situation to other responses.

The first assumption may be stated more exactly, after Hull's (5, p. 183) "principle of stimulus generalization" though still in a qualitative form, as follows: During practice, a response is set up not only to the stimulus used, but to a family of similar stimuli, the strength of the response to any particular stimulus being directly proportional to the similarity of the particular stimulus to the stimulus used in training. Two studies by Hovland (3, 4) lend experimental support to this assumption.

In order to make this postulate quantitative, it would be necessary to state a function of similarity. However, certain conditions for film production may be deduced without introducing quantitative rigor. It may be deduced that, for greatest efficiency of learning, the stimuli presented in the film should be as similar as possible to the stimuli which would occur in the actual performance (or test) of the desired learning. It is implied, therefore, that the film representation should approximate, as nearly as practicable, the details of the actual stimulus in terms of color, shading, perspective, movement, sounds, content, etc. It should be stated

PARENTHETICALLY THAT FOR SOME STIMULI DIFFERENCES IN SHADING, FOR INSTANCE, MAY BE VERY CLOSE ON A SCALE OF SIMILARITY, AND THUS , FOR PRACTICAL PURPOSES BE INCONSEQUENTIAL.

IN A PERCEPTUAL-MOTOR ACT, THE STIMULUS AND THE OCCASIONED ACT ARE CONSTANTLY CHANGING. THESE CHANGES MAY BE OF TWO KINDS: FIRST, THERE MAY BE CONTINUOUS CHANGES IN THE OBJECT ACTED UPON, AS IN A PURSUIT TASK, OR THERE MAY BE A RADICALLY CHANGED CONFIGURATION OF THE OBJECT ACTED UPON, AS IN AN ASSEMBLY TASK. SECOND, THERE MAY BE CHANGES IN THE POSITIONING OF THE PARTS OF THE BODY OF THE PERFORMER (E.G. THE PERFORMER'S HANDS), AND IN THIS EVENT SUCH POSITIONAL CHANGES BECOME THE STIMULI FOR FURTHER ACTION. IF THE FILM-MEDIATED LEARNING SITUATION IS TO REPRESENT THE ACTUAL STIMULUS OF THE TEST SITUATION, THEREFORE, IT MUST REPRODUCE ALL THESE CHANGES AS EXACTLY AS POSSIBLE.

HENCE THE MAJOR HYPOTHESIS OF THIS STUDY FOLLOWS: THE LEARNING OF A PERCEPTUAL-MOTOR ACT, FROM FILMS, WILL BE MORE EFFECTIVE AS THE FILM PRESENTATION APPROACHES AN EXACT REPRESENTATION OF THE LEARNER HIMSELF PERFORMING THE ACT OR ACTS TO BE LEARNED.

THE THIRD ASSUMPTION MAY BE RESTATED IN AN ANALOGOUS FASHION: DURING PRACTICE, A FAMILY OF RESPONSES IS SET UP TO THE STIMULUS USED IN ADDITION TO THE PRACTICED RESPONSE, THE STRENGTH OF ANY PARTICULAR RESPONSE BEING DIRECTLY PROPORTIONAL TO THE SIMILARITY OF THE PARTICULAR RESPONSE TO THE RESPONSE PRACTICED[1] (THE "PRINCIPLE OF RESPONSE GENERALIZATION" (5 P. 183)). IT MIGHT SIMPLY BE ASSUMED, AS PREVIOUSLY, THAT THE LEARNER WILL IN SOME WAY RESPOND TO THE STIMULI. THIS POSTULATE, HOWEVER, IMPLIES THAT THE FILM LEARNING SITUATION SHOULD BE SO DESIGNED AS TO APPROXIMATE AS NEARLY AS POSSIBLE THE ACTUAL RESPONSES OF THE PERFORMANCE OR TEST SITUATION. FOR INSTANCE, FOR CERTAIN TASKS IT MAY BE POSSIBLE TO HAVE THE LEARNER PERFORM THE OPERATION DEPICTED BY THE FILM AS THE FILM IS BEING SHOWN. AGAIN, THE MAJOR HYPOTHESIS FOLLOWS.

THE PRECEDING DERIVATION OF THE MAJOR HYPOTHESIS IS ADEQUATE TO THE PURPOSES OF THIS STUDY. IT MAY, HOWEVER, BE OF INTEREST TO CARRY THE DISCUSSION SOMEWHAT FURTHER.

FOLLOWING THE ANALYSIS OF GAGNE AND FOSTER (1), WHO SEPARATE THE MOTOR AND PERCEPTUAL ASPECTS IN THEIR DISCUSSION, IT MAY BE THAT FOR A LARGE NUMBER OF TASKS

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[1] IT WOULD NOW BE POSSIBLE TO DERIVE A STATEMENT SIMILAR TO HULL'S THIRD PRINCIPLE OF GENERALIZATION, STIMULUS - RESPONSE GENERALIZATION, BUT THIS IS CONSIDERED UNNECESSARY.

THE MOVEMENTS INVOLVED ARE ALREADY A PART OF THE LEARNERS' REPERTOIRE AND ARE WELL PRACTICED. THE PROBLEM THEN BECOMES ONE OF THE ADEQUACY OF THE PERCEPTUAL ASPECTS OF TRAINING. THIS PERCEPTUAL ADEQUACY IS OF MAJOR CONCERN FOR FILM INSTRUCTION, AND IS EMPHASIZED IN THIS PAPER.

IF, IN ADDITION TO THE PREVIOUSLY STATED POSTULATES, IT WERE FURTHER ASSUMED THAT THE SUBJECT HAS LEARNED TO MAKE CERTAIN RESPONSES ON THE OCCASION OF PERCEIVING THE SENSORY CONSEQUENCES OF SUCH MOVEMENTS, IT IS IMPORTANT THAT THE FILM, WITHIN ITS LIMITATIONS, APPROXIMATE THESE SENSORY CONSEQUENCES BY BEING AS COMPLETE AND REALISTIC AS POSSIBLE.

THE FOREGOING DISCUSSION HAS IMPORTANT IMPLICATIONS FOR THE PROBLEMS OF LEARNER-PROTAGONIST IDENTIFICATION IN THE FILM TRAINING SITUATION. IDENTIFICATION IS HERE CONCEIVED IN THE SENSE OF "ACTING ALONG." THE LEARNER IS SAID TO IDENTIFY WITH THE FILM PROTAGONIST IF HE "ACTS ALONG WITH" THE ACTOR IN THE FILM. NEGLECTING OTHER DIMENSIONS OF IDENTIFICATION, IT IS SUGGESTED THAT ONE OF THE VARIABLES INVOLVED IS THAT OF THE SIMILARITY BETWEEN THE FILM PROTAGONIST AND THE LEARNER. THE LEARNER HAS EXPERIENCED SENSORY CONSEQUENCES IN TERMS OF HIMSELF. IF THE PERCEPTION OF SENSORY CONSEQUENCES CAN EVOKE THE ACT, THE MOST EFFECTIVE LEARNING WOULD OCCUR WHEN THE PROTAGONIST IS MOST LIKE THE LEARNER.

II. EXPERIMENTAL DESIGN AND PROCEDURES

TO TEST THE VALIDITY OF THE MAJOR HYPOTHESIS OF THIS RESEARCH, FOUR LIMITED PROPOSITIONS, EACH OF WHICH COULD BE TRANSLATED INTO AN APPROPRIATE FILM VARIABLE, WERE DEDUCED. A SIMPLE PERCEPTUAL-MOTOR TASK -- THE TYING OF EACH OF THREE STANDARD KNOTS -- WAS SELECTED, AND EIGHT VERSIONS OF A FILM WERE PRODUCED DEMONSTRATING THE TYING OF THESE KNOTS. EACH OF THE EIGHT FILM VERSIONS INVOLVED A UNIQUE COMBINATION OF ONE OF THE ALTERNATIVES FOR EACH VARIABLE. THESE FILM VERSIONS WERE SHOWN TO GROUPS OF NAVY RECRUIT TRAINEES, WHO WERE DIRECTED TO TIE EACH KNOT IMMEDIATELY AFTER SEEING THE FILM DEMONSTRATION OF IT.

THE EXPERIMENTAL HYPOTHESES AND FILM VERSIONS

THE EXPERIMENTER IS ALWAYS CONFRONTED WITH THE POSSIBILITY THAT A GENERAL HYPOTHESIS MAY BE TRUE BUT UNSUPPORTED BY HIS EXPERIMENT BECAUSE (A) THE EXTENSION TO THE EXPERIMENTAL HYPOTHESES IS ILLOGICAL, (B) THE PARTICULAR SITUATION SELECTED IS IRREVELANT, AND/OR (C) THE EXPERIMENTAL DESIGN EMPLOYED IS NOT SENSITIVE ENOUGH TO DETECT THE DIFFERENCES IN RESULTS THAT OCCUR AS A CONSEQUENCE OF THE EXPERIMENTAL VARIABLES.

A PARTICULARLY CRUCIAL ISSUE ARISES IN THE APPLICATION OF THE CONCEPT OF SIMILARITY, AS IT APPLIES TO THE RELATIONSHIP BETWEEN THE FILM AND THE PERFORMANCE SITUATION OF WHICH IT IS A REPRESENTATION. SINCE SIMILARITY IS NOT QUANTITATIVELY DEFINED, POINTS ON THE CONTINUUM CANNOT BE LOCATED DEFINITELY. THE PROBLEM COULD BE HANDLED IN ONE OF THREE WAYS. FIRST, SOME EXTERNAL CRITERION COULD BE SET UP FOR SCALING SIMILARITY, AND POINTS ON A (MORE OR LESS ARBITRARY) CONTINUUM COULD BE IDENTIFIED. SECOND, SIMILARITY MIGHT BE TREATED AS AN INTERVENING VARIABLE. THIRD, ONE MIGHT TRY TO CHOOSE POINTS THAT ARE "OBVIOUSLY" FAR APART. THE LAST METHOD WAS FOLLOWED IN THIS EXPERIMENT. THE ATTENDANT DIFFICULTIES REQUIRE LITTLE ELABORATION.

THE EXPERIMENTAL HYPOTHESES AND FILM VARIABLES. WITH THESE CONSIDERATIONS IN MIND, THE FOUR LIMITED EXPERIMENTAL HYPOTHESES, AND THEIR ASSOCIATED FILM VARIABLES, MAY BE STATED AS FOLLOWS:

1. MOTION. THE FIRST HYPOTHESIS IS THAT: FILM-MEDIATED PERCEPTUAL-MOTOR LEARNING WILL BE MORE EFFECTIVE AS THE FILM MORE ACCURATELY REPRESENTS ALL THE CHANGES IN THE OBJECT ACTED UPON.

THIS HYPOTHESIS IS TESTED BY A COMPARISON OF FILM VERSIONS WHICH SHOW CONTINUOUS MOVEMENTS OR "LIVE ACTION", WITH STATIC VERSIONS SHOWING ONLY SUCCESSIVE STAGES IN THE KNOT-TYING PROCESS. THE VARIABLE INVOLVED IS CALLED MOTION. FROM THE HYPOTHESIS IT WOULD BE PREDICTED THAT A VERSION INCORPORATING MOTION SHOULD BE MORE EFFECTIVE THAN A STATIC VERSION.

2. HANDS. THE SECOND HYPOTHESIS IS THAT: FILM-MEDIATED PERCEPTUAL-MOTOR LEARNING WILL BE MORE EFFECTIVE AS THE FILM MORE ACCURATELY REPRESENTS THE DISPOSITION OF THE REVELANT BODY PARTS OF THE PERFORMER.

IT HAS BEEN POINTED OUT IN THE PREVIOUS CHAPTER THAT THE DISPOSITION OF THE BODY PARTS OF THE PERFORMER SHOULD BE CONSIDERED AS PART OF THE STIMULUS, AND FURTHER, THAT CHANGES IN THEIR DISPOSITION CONSTITUTE STIMULI FOR FURTHER ACTION. A FILM, THEN, WHICH SHOWS THE DISPOSITION OF THE BODY PARTS SHOULD BE MORE EFFECTIVE THAN A FILM WHICH DOES NOT. SINCE THE REVELANT BODY PARTS FOR THE TASK SELECTED ARE THE HANDS, THE VARIABLE SUBSUMED HAS BEEN NAMED HANDS.

IT HAD BEEN INTENDED TO TEST THIS HYPOTHESIS BY THE COMPARISON OF AN ANIMATED FILM VERSION WHICH SHOWED CONTINUOUS MOTION WITHOUT A HUMAN AGENT, WITH A VERSION SHOWING LIVE ACTION INCLUDING THE HAND MOVEMENTS. THIS WAS DISCARDED BECAUSE OF THE EXPENSE OF ANIMATION, AND, WITH SOME MISGIVINGS ABOUT THEIR SEPARATION ON THE SIMILARITY CONTINUUM, A COMPARISON OF STATIC VERSIONS WAS SUBSTITUTED. IN TWO VERSIONS THE HANDS ARE SHOWN, AND IN TWO OTHERS THE SEQUENCE OF STEPS IS SHOWN IN THE FILM BY SHOWING THE LINE WITHOUT HANDS.

3. Camera angle. The third hypothesis is that: Film mediated perceptual-motor learning will be more effective as the film more accurately represents the visual stimuli, as the learner would actually see them in performing the act.

An obvious consideration in the presentation of a perceptual-motor task is the point of view or perceptual orientation used. If the film situation is to approach a representation of the learner himself performing the perceptual-motor act, the screen presentation must show the act as nearly as possible as it will actually appear to the learner as performer. This means that the camera should be oriented with respect to the task as a learner would be oriented in performing the task, rather than as a learner in a classroom audience watching an instructor. The former orientation is known to professional motion picture workers as the "subjective camera angle", while the latter is called the "objective" or "observer camera angle." In this study they have been termed the 0 degree camera angle and the 180 degree camera angle, respectively. There can be no doubt that two distant points on the similarity continuum are thus depicted. From the hypothesis it maybe deduced that the films employing the 0 degree camera angle should be more effective than those employing the 180 degree angle.

4. Participation. The fourth hypothesis is that: Film mediated perceptual-motor learning will be more effective as learner response during the film presentation approaches the response required in the actual performance (or test).[2]

It has been assumed that, during the film presentation, the learner does respond in some way. The response might be symbolical in terms of the commentary. All of the films carry a sound track explanation of the task. It is clear, however, that actually following through the desired response overtly is closer to actually performing the desired act in the test situation than any implicit response would be. If, then, the learner follows through the movements while watching the film, learning should be facilitated. Film versions which allow opportunities for such participation should be better than corresponding non-participation versions.

The film versions. Eight versions of a film demonstrating the tying of three knots were produced. The specific content of each version is presented in outline in the appendix. In each version, each of the three knots was treated in the same fashion with respect to the film variables. Between each knot sequence was inserted a length of blank film, to warn the operator that the projector should be stopped for the test of learning on the preceding knot. Of the eight versions, four employed motion and four were static; six presented hands (all motion versions and

[2]Predictions similar to those derived from the third and fourth hypotheses were made by May (9).

TWO STATIC VERSIONS) WHILE TWO (STATIC) VERSIONS DID NOT SHOW HANDS; SIX WERE PHOTOGRAPHED FROM THE 0 DEGREE CAMERA ANGLE AND TWO FROM THE 180 DEGREE CAMERA ANGLE. FINALLY, FOUR VERSIONS CALLED FOR PARTICIPATION, WHILE THE OTHER FOUR, CORRESPONDING WITH RESPECT TO THE PREVIOUS THREE VARIABLES, DID NOT CALL FOR PARTICIPATION. THE DISTRIBUTION OF VARIABLES IN THE FILM VERSIONS IS PRESENTED IN TABLE I.

IN TERMS OF THE FOUR HYPOTHESES PROPOSED FOR TEST, THE FOLLOWING RELATIONSHIPS SHOULD OBTAIN AMONG THE VERSIONS:

1. MOTION. VERSION IV (O-M-H-NP) SHOULD BE MORE EFFECTIVE THAN EITHER VERSIONS II (O-S-NH-NP) OR III (O-S-H-NP) AND VERSION (O-M-H-P) SHOULD BE MORE EFFECTIVE THAN EITHER VI (O-S-NH-P) OR VII (O-S-H-P).

2. HANDS. VERSION III (O-S-H-NP) SHOULD BE MORE EFFECTIVE THAN VERSION II (O-S-NH-NP) AND VERSION VII (O-S-H-P) SHOULD BE MORE EFFECTIVE THAN VERSION VI (O-S-NH-P).

3. CAMERA ANGLE. VERSION IV (C-M-H-NP) SHOULD BE MORE EFFECTIVE THAN I (180-M-H-NP), AND VIII (O-M-H-P) SHOULD BE MORE EFFECTIVE THAN V (180-M-H-P).

4. PARTICIPATION. VERSIONS V, VI, VII, VIII SHOULD BE MORE EFFECTIVE THAN VERSIONS I, II, III, IV, RESPECTIVELY.

5. OVER-ALL ORDER. IN TERMS OF THE MAJOR HYPOTHESIS, CERTAIN HIERARCHIES OF EFFECTIVENESS MAY BE PREDICTED.[3] VERSION VIII, CHARACTERIZED BY MOTION, HANDS, 0 DEGREE ANGLE, AND PARTICIPATION, SHOULD BE THE MOST EFFECTIVE OF ALL EIGHT. FROM A CONSIDERATION OF THEIR PLACEMENT ON THE SIMILARITY CONTINUUM, VERSION IV SHOULD BE THE MOST EFFECTIVE OF THE FOUR NON-PARTICIPATION VERSIONS. VERSIONS IV, III AND II SHOULD OCCUR IN THAT ORDER, AND SIMILARLY VIII, VII, AND VI.

THE TASK

THE DEVISING OF AN EXPERIMENTAL SITUATION WHICH IS APPROPRIATE TO THE HYPOTHESES IS CRUCIAL IN ALL RESEARCH. A RECURRENT ASPECT OF THIS PROBLEM IN MOTION PICTURE RESEARCH IS THE SELECTION OF A SUITABLE TASK. THE FOLLOWING CRITERIA WERE PROPOSED FOR THE TASK TO BE SHOWN FOR THIS STUDY:

1. IT SHOULD BE SIMPLE ENOUGH SO THAT AT LEAST A PORTION OF THE TESTED POPULATION COULD PERFORM IT AFTER ONE FILM DEMONSTRATION, BUT DIFFICULT ENOUGH SO THAT NOT EVERYONE WOULD BE LIKELY TO SUCCEED.

2. CORRECT PERFORMANCE OF THE TASK SHOULD DEPEND

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[3] THESE ARE CONTAINED MORE OR LESS EXPLICITLY IN THE DISCUSSION OF THE FOUR SUBSIDIARY HYPOTHESES.

TABLE I

FILM VERSIONS

VERSION	MOTION (M-S)	HANDS (H-NH)	CAMERA ANGLE (0-180)	PARTICIPATION (P-NP)
I (180-M-H-NP)*	MOTION	HANDS	180°	NO PARTICIPATION
II (0-S-NH-NP)	STATIC	NO HANDS	0°	NO PARTICIPATION
III (0-S-H-NP)	STATIC	HANDS	0°	NO PARTICIPATION
IV (0-M-H-NP)	MOTION	HANDS	0°	NO PARTICIPATION
V (180-M-H-P)	MOTION	HANDS	180°	PARTICIPATION
VI (0-S-NH-P)	STATIC	NO HANDS	0°	PARTICIPATION
VII (0-S-H-P)	STATIC	HANDS	0°	PARTICIPATION
VIII (0-M-H-P)	MOTION	HANDS	0°	PARTICIPATION

* SYMBOLS INDICATE:

180 = 180 DEGREE CAMERA ANGLE

0 = 0 DEGREE CAMERA ANGLE

M = MOTION

S = STATIC

H = HANDS

NH = NO HANDS

P = PARTICIPATION

NP = NO PARTICIPATION

PRIMARILY ON LEARNING FROM THE INSTRUCTIONAL MEDIUM, AND NOT ON AN INSIGHT THAT COULD COME FROM THE INITIAL DISPOSITION OF THE ELEMENTS OR MATERIALS INVOLVED, OR THE DISCOVERY OF A "TRICK."

3. THE TASK SHOULD BE OF A KIND SUCH THAT SEVERAL SPECIFIC INSTANCES OF VARYING DIFFICULTY COULD BE IDENTIFIED.

4. IT SHOULD PERMIT OF A RELATIVELY OBJECTIVE METHOD OF SCORING, AND SHOULD LEND ITSELF READILY TO TESTING. PREFERABLY THE TASK SHOULD PERMIT TESTING RATHER LARGE GROUPS.

5. THE TASK SHOULD INCORPORATE ELEMENTS THAT WOULD PERMIT THE PRODUCTION OF EXPERIMENTAL FILM VERSIONS IN WHICH THE VARIABLES PREVIOUSLY DESCRIBED COULD BE MANIPULATED.

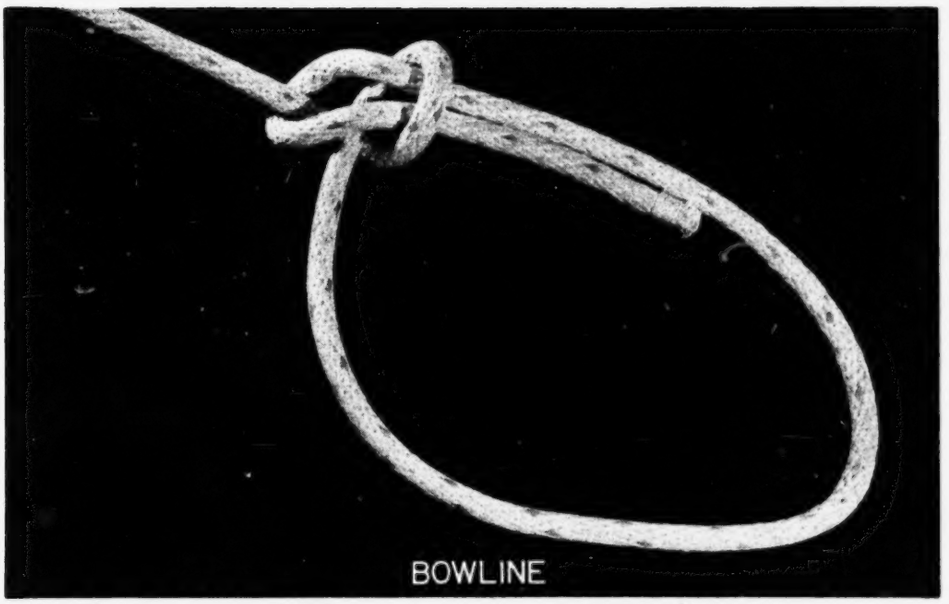
THE TASK OF TYING OF THREE KNOTS, THE BOWLINE, THE SHEET BEND, AND THE SPANISH BOWLINE, APPEARED TO MEET ALL THE CRITERIA STIPULATED. THE THREE KNOTS ARE ILLUSTRATED IN FIGURE 1. THREE KNOTS WERE USED TO ENHANCE THE LIKELIHOOD OF A SPREAD IN PERFORMANCE IN THE RESULTS. FOR EXAMPLE, IF ALL THE SUBJECTS COULD TIE A KNOT AFTER SEEING THE FILM, INDEPENDENT OF THE PARTICULAR VERSION VIEWED, NO COMPARISON COULD BE MADE. THE SAME WOULD BE TRUE IF NONE OF THE SUBJECTS SUCCEEDED IN TYING A KNOT. IT WAS ALSO THOUGHT DESIRABLE TO OBTAIN AN ESTIMATE, HOWEVER INDIRECT, ON THE INTERACTION OF THE POSTULATED VARIABLES WITH THE DIFFICULTY. THIS WOULD HAVE REQUIRED A COMPLETE CONFOUNDING OF THE ORDER OF PRESENTATION OF KNOTS OF KNOWN DIFFICULTY, AND WOULD HAVE EXPANDED THE STUDY TO PROHIBITIVE PROPORTIONS.

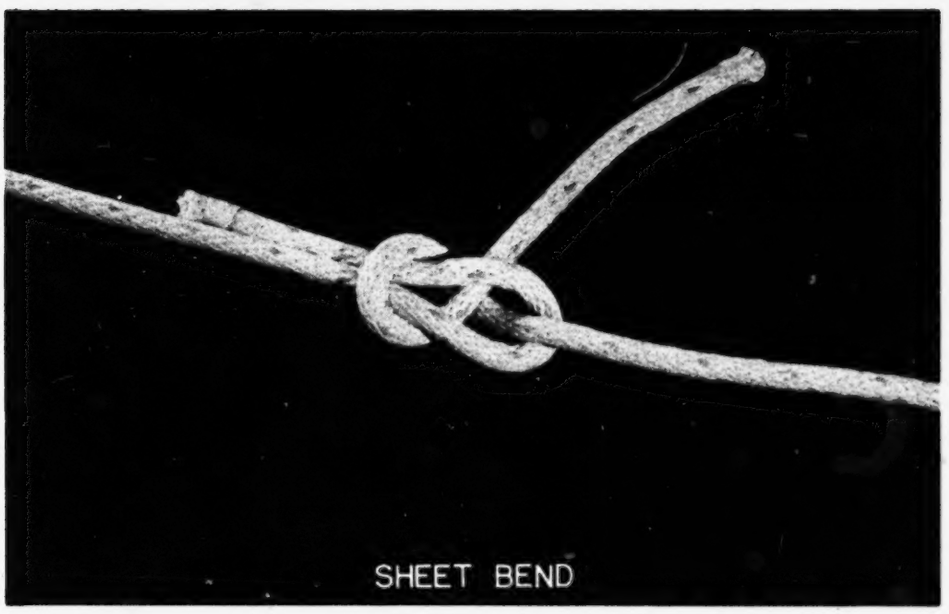
A PRELIMINARY TRYOUT OF THE TASK WITH COLLEGE STUDENTS INDICATED THAT ONE MIGHT ANTICIPATE A RANGE OF PERFORMANCE (FROM SUCCESS TO FAILURE) FOR EACH KNOT. FURTHERMORE, FOR THIS POPULATION THE KNOTS WERE OF DISTINCTLY VARYING DIFFICULTY, THE BOWLINE BEING THE EASIEST AND THE SPANISH BOWLINE THE MOST DIFFICULT.

TEST CONSIDERATIONS. THE TASK ALSO LENT ITSELF WELL TO GROUP TESTING. ENOUGH LINE COULD BE PROVIDED TO PERMIT EACH SUBJECT TO TIE EACH KNOT, AND THE TIED KNOTS COULD BE RETAINED FOR SUBSEQUENT SCORING.

WHILE GROUP TESTING PRESENTS DEFINITE ADVANTAGES, HOWEVER, THE SHORTCOMINGS OF THE PROCEDURE SHOULD NOT BE NEGLECTED. WHEN HANDLING LARGE GROUPS, IT IS IMPOSSIBLE (UNLESS EQUALLY LARGE GROUPS OF SKILLED PROCTORS ARE AVAILABLE) TO MAKE CONTINUOUS OBSERVATIONS OF EACH SUBJECT'S PERFORMANCE. THEREFORE, ONLY THE END-PRODUCT CAN BE SCORED.

IF IT IS HELD THAT THE PURPOSE OF THE LEARNING IS TO LEAD TO THE PERFORMANCE OF ANY ACT TO PRODUCE A PARTICULAR PRODUCT, THERE NEEDS TO BE NO DISCUSSION OF THIS POINT.





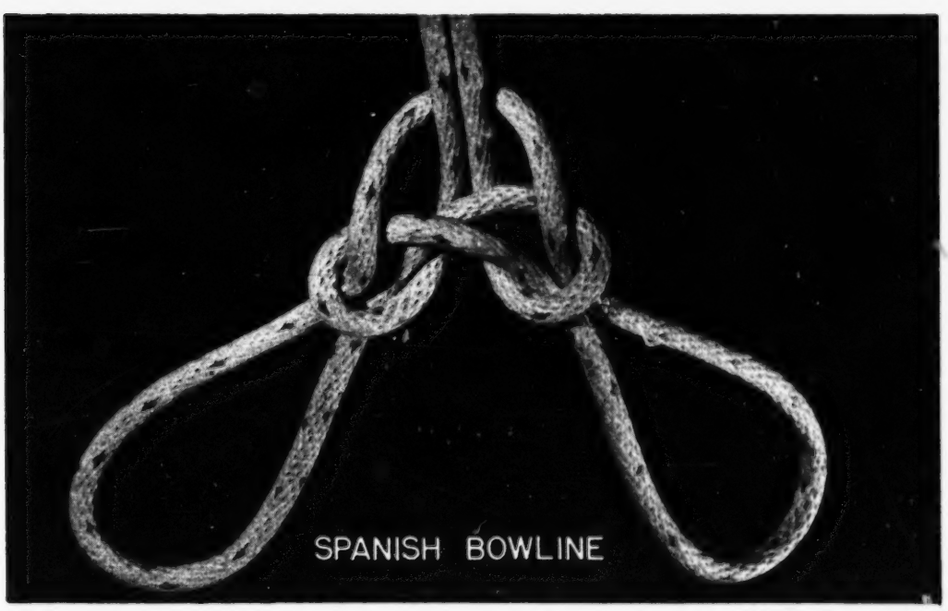


FIGURE 1. Knots used in the experiment

IF, ON THE OTHER HAND, THE PURPOSE IS TO TEACH A PERCEPTUAL-MOTOR ACT IN ALL ITS ASPECTS (I.E., A SINGLE "RIGHT" SET OF MOVEMENTS FOR TYING EACH KNOT), THEN THE SCORING OF THE END PRODUCT ONLY MAY LEAD TO AN ATTENUATION OF THE DATA BY INCLUSION OF CORRECT KNOTS (END-PRODUCTS) TIED BY USE OF INCORRECT MOVEMENTS. THIS ATTENUATION WOULD PROBABLY WORK AGAINST THE EXPERIMENTAL HYPOTHESES.

SINCE THE STUDY WAS TO BE CONDUCTED WITH NAVY RECRUITS, KNOT-TYING HAD THE ADDITIONAL ADVANTAGE OF FACE VALIDITY FOR THE TRAINEES.

TEST POPULATION

ABOUT 4,200 RECRUITS IN COMPANIES OF APPROXIMATELY 130 MEN EACH AT THE GREAT LAKES NAVAL TRAINING CENTER, GREAT LAKES, ILLINOIS, PARTICIPATED IN THE EXPERIMENT. THE USE OF SEVERAL COMPANIES FOR EXPLORING PROCEDURE, WASTAGE DUE TO PROJECTOR BREAKDOWNS, AND INCOMPLETE CASES, RESULTED IN AN ATTRITION OF THE EXPERIMENTAL POPULATION TO 3314. TWENTY-EIGHT COMPANIES, ONE FOR EACH POSSIBLE PAIRING OF THE EIGHT FILMS, WERE USED. IT IS STATION PRACTICE TO FORM COMPANIES OF MEN IN THE ORDER OF ARRIVAL AND WITHOUT OTHER SELECTION EXCEPT, FOR THOSE REQUIRING HOSPITALIZATION OR EXTENSIVE DENTAL WORK. THE MEN WERE ALL IN THEIR FIRST WEEK OF TRAINING AND HAD NO FORMAL TRAINING IN SEAMANSHIP. CHECKS ON INFORMAL TRAINING WERE MADE BY INTERVIEWING THE COMPANY COMMANDERS AND SAMPLES OF THE RECRUITS.

EXPERIMENTAL PROCEDURES

MATERIALS. THE EIGHT FILM VERSIONS, EACH SHOWING THE TYING OF THE BOWLINE, THE SHEET BEND, AND THE SPANISH BOWLINE, HAVE ALREADY BEEN DESCRIBED. THE SECTIONS OF VERSION I ARE A FEW SECONDS LONGER THAN THE CORRESPONDING SECTIONS OF THE OTHER VERSIONS. HOWEVER, IT IS UNLIKELY THAT THIS SMALL DISCREPANCY COULD ACCOUNT FOR ANY OF THE FINDINGS. IN ANY CASE, IT SHOULD WORK AGAINST THE CAMERA ANGLE HYPOTHESIS.

GROUP TESTING REQUIRED THE PREPARATION OF MANY DUPLICATIONS OF THE TEST MATERIALS. SUFFICIENT SIX-FOOT LENGTHS OF #7 SASH CORD WERE PROVIDED FOR TESTING AT LEAST TWO COMPANIES WITHOUT REUSE. THE ENDS OF THE LINES WERE CEMENTED TO PREVENT RAVELLING. THE LINES WERE INSERTED IN 10"x 13" MANILA ENVELOPS. STAMPED ON THE FACE OF EACH ENVELOP, IN LARGE LETTERS, WAS THE NAME OF THE KNOT FOR WHICH THE INCLUDED LINE WAS TO BE USED. A TICKET WAS PASTED ON EACH ENVELOP TO PROVIDE FOR IDENTIFICATION OF THE LEARNER AND LATER ENTRY OF THE SCORE ON THE KNOT.

THE TEST SITUATION. A COMPLETELY SYMMETRICAL DESIGN PERMITTING THE COMPARISON OF EACH VERSION WITH EVERY OTHER VERSION WAS DEVISED. IN ALL, THIS DESIGN CALLED FOR 28 PAIRS

OF FILM SHOWINGS. SINCE EACH FILM VERSION OCCURS SEVEN TIMES AMONG THE 28 COMBINATIONS, EACH VERSION WAS SHOWN TO ONE HALF OF EACH OF SEVEN COMPANIES.

IT HAD BEEN THE EXPERIMENTERS' INTENT TO ASSIGN THE FILM PAIRS TO COMPANIES AT RANDOM. THE PAIRS WERE ORDERED I-II, I-III, ..., II-III, II-IV, ..., VII-VIII, AND NUMBERED SERIALLY. THE ORDER OF THE SERIAL NUMBERS WAS THEN CHANGED IN CONFORMANCE WITH THE TABLE OF RANDOM NUMBERS GIVEN BY PEATMAN (11, P. 543-545). THIS ORDER WAS FOLLOWED EXCEPT FOR TWO PRESENTATIONS, WHICH HAD TO BE DISCARDED BECAUSE OF PROJECTOR BREAKDOWNS. THESE PRESENTATIONS WERE REPEATED AFTER COMPLETION OF THE ENTIRE SERIES. THE DISTRIBUTION OF COMPANIES BY FILM VERSION IS GIVEN IN TABLE 2. THE DATA FROM COMPANIES 445 AND 461 WERE DISCARDED FOR THE REASONS CITED.

PROCTORS. PROCTORS WERE PROVIDED BY THE NAVAL TRAINNING STATION. THE PROCTORS ASSIGNED TO THE EXPERIMENTERS ASSISTED IN THE HANDLING OF THE MATERIALS, POLICING OF THE TEST SITUATION, AND THE SCORING OF THE KNOTS. THESE PROCTORS WERE RECRUITS WHO HAD COMPLETED SEVERAL WEEKS OF TRAINING. AN ATTEMPT WAS MADE TO SELECT MEN WHO SCORED HIGH ON BOTH THE NAVY GENERAL CLASSIFICATION AND THE MECHANICAL APTITUDE TESTS. A NEW GROUP OF PROCTORS WAS SUPPLIED FOR EACH WORK WEEK. THE PROCTORS WERE TRAINED ON THE SATURDAY IMMEDIATELY PRECEDING THE WEEK OF SERVICE.

TEST ROOMS. TWO TEST ROOMS WERE SET UP, EACH ACCOMMODATING OVER SIXTY TEST POSITIONS.

BEFORE THE TEST COMPANIES APPEARED, THE PROCTORS PLACED THREE ENVELOPS EACH CONTAINING A LINE, ONE FOR EACH KNOT, ON ALTERNATE SEATS OF THE CLASSROOMS. FOR THE PARTICIPATION VERSIONS, SIX ENVELOPS WERE USED. THE MEN RETURNED THE LINES TO THESE SAME ENVELOPS AFTER ATTEMPTING TO TIE THE KNOTS.

EACH COMPANY WAS SPLIT IN HALF AT THE CLASSROOM DOORS BY ASSIGNING EVERY OTHER MAN IN THE MARCHING ORDER TO EACH OF THE TWO ROOMS USED. IT WAS NOT POSSIBLE TO RANDOMIZE THE GROUPS PRIOR TO THEIR APPEARANCE. HOWEVER, IT WAS FELT THAT THE PROCEDURE USED WAS ADEQUATE TO OBTAIN RANDOMIZATION.

PROCEDURE. AFTER THE SUBJECTS WERE SEATED, THEY WERE TOLD IN A MORE OR LESS INFORMAL MANNER, THAT:

> "YOU ARE HERE, THIS MORNING (AFTERNOON) TO TAKE PART IN A SPECIAL STUDY OF RECRUIT TRAINING BEING CONDUCTED BY THE OFFICE OF NAVAL RESEARCH. YOU WILL BE SHOWN THREE SHORT FILMS. EACH OF THESE FILMS WILL SHOW YOU HOW TO TIE A KNOT. IMMEDIATELY AFTER THE FILM, YOU WILL BE ASKED TO TIE THE KNOT. THE FILMS ARE VERY SHORT SO YOU WILL HAVE TO STAY RIGHT WITH THEM.
>
> "IN ORDER TO KEEP THINGS MOVING IN THIS ROOM, YOU WILL NOT TALK AT ANY TIME, YOU WILL NOT HANDLE THE MATE-

TABLE 2

DISTRIBUTION OF PRESENTATION OF FILM VERSIONS

Company	Half	Version	Company	Half	Version	Company	Half	Version
445	A	I	448	A	VI	453	A	VII
	B	II		B	VIII		B	III
438	A	VII	449	A	IV	459	A	I
	B	II		B	II		B	VIII
437	A	II	455	A	VI	*461	A	I
	B	V		B	I		B	V
442	A	IV	457	A	IV	462	A	V
	B	I		B	VIII		B	IV
*444	A	I	456	A	III	466	A	V
	B	VII		B	VI		B	VIII
447	A	III	458	A	VIII	465	A	VIII
	B	I		B	II		B	III
450	A	IV	460	A	II	464	A	VI
	B	III		B	III		B	V
443	A	VI	454	A	V	467	A	VII
	B	II		B	III		B	IV
446	A	IV	452	A	V	468	A	I
	B	VI		B	VII		B	VII
451	A	VII	463	A	VIII	470	A	I
	B	VI		B	VII		B	V

*Discarded.

RIALS UNTIL I TELL YOU TO DO SO, AND WHEN I DO, YOU WILL DO SO QUICKLY. IS THAT UNDERSTOOD?"

THE MEN ENTERED IDENTIFICATION INFORMATION (NAME, SERIAL NUMBER, COMPANY, DATE) ON THE TICKETS, AND THEN THE FIRST FILM WAS SHOWN. FOR PARTICIPATION VERSIONS, INSTRUCTIONS WERE GIVEN TO TAKE THE LINE FROM THE APPROPRIATE ENVELOP AND TIE THE KNOT WHILE IT WAS BEING TIED ON THE SCREEN. (THESE INSTRUCTIONS WERE REPEATED IN THE FILMS.) PROJECTION WAS HANDLED BY THE REGULAR SEAMANSHIP INSTRUCTORS.

ONE FILM OF EACH PAIR WAS PRESENTED TO A RANDOM-HALF (THE A-HALF) OF EACH COMPANY AND THE OTHER FILM WAS PRESENTED TO THE SECOND (B) HALF OF THE COMPANY. THE TWO EXPERIMENTERS ALTERNATED IN THE SUPERVISION OF THE TEST SITUATIONS FOR THE SEVERAL FILMS.

THE PROJECTOR WAS STOPPED AFTER THE SHOWING OF EACH KNOT. THE MEN TOOK LINES FROM THE APPROPRIATE ENVELOPS AND ATTEMPTED TO TIE THE KNOTS WITHIN A TWO MINUTE TIME LIMIT. THESE KNOTS WERE LATER SCORED BY THE PROCTORS, WHO HAD AVAILABLE REFERENCE PHOTOGRAPHS OF THE CORRECT KNOTS AND SEVERAL INCORRECT VARIANTS. BOTH PRACTICE AND TEST KNOTS WERE SCORED.

AFTER THE KNOT-TYING, THE SPACE SUBTEST OF THE SRA PRIMARY ABILITIES TEST WAS ADMINISTERED. THIS WAS FOR A STUDY BEING CONDUCTED BY VANDERMEER (14), ON PERSONAL CHARACTERISTICS AND THEIR RELATION TO LEARNING FROM SOUND MOTION PICTURES.

III. RESULTS AND DISCUSSION

Plan of the Analysis

The knots were scored either right or wrong. However, additional information on tied variants of the correct knots was collected for possible use in the event that the simple pass-fail criterion should prove too crude to detect differences among the versions even with the large population used. There was, then, available for each individual a score of right (assigned a value of "1") or wrong (assigned a value of "0") on each knot and a total score for the three knots. Counting "1" for each correct knot and "0" for each incorrect knot yielded a total score range of 0 to 3.

In order to compensate for the possibility that the differences in effectiveness among the film versions may have been too slight to appear in any striking fashion for individual learners, the effects were summed over the population. To further increase sensitivity the effects were also summed over the three knots.

Since each of the 28 companies was split into random halves and one of the 28 possible pairings of versions was presented, in random order, to each company, two different analyses, based upon different sampling assumptions, were possible for each of the knots and for the total score for the three knots.

For purposes of discussion these two analyses are called the grouped-data method and the random-half control method.

In the first analysis (grouped-data method), the scores were grouped for all seven half-companies viewing a particular film version. Statistical evaluation was made in terms of these summed scores for seven half-companies. This grouping is based on the assumption that the probability of biasing the sample in favor of any given version is very low when seven randomly selected half-companies are used. It must be pointed out, however, that the standard errors used in the analysis do not take account of this type of sampling error. There is only the assumption that it is very low.

The second analysis (random-half control method) makes use of the seven replications involved in the random-half control. There is first a direct comparison, using one company for each film pairing. By controlling on the other six film versions, six more indirect comparisons are made available. For example, versions I and II were paired and presented to random halves of one company. The same was done for the pairs I and III, and II and III. By pivoting on film III, an indirect comparison of I and II can be made: (I - III) - (II - III') = I - II (where III and III' indicate two presentations of Version III). Of course, III is not necessarily equal to III', but it is assumed that except for random sampling error, an

ESTIMATE OF WHICH ENTERS THE STANDARD ERROR FORMULATION, ANY DIFFERENCE BETWEEN III AND III' REFLECTS SYSTEMATIC DIFFERENCES IN THE POPULATIONS WHICH ARE THUS CONTROLLED. IT IS FURTHER ASSUMED THAT THESE SYSTEMATIC EFFECTS ARE ADDITIVE AND THAT, FOR PRESENT PURPOSES, A DIFFERENCE OF 10 PER CENT OF CORRECTLY TIED KNOTS BETWEEN 50 PER CENT AND 60 PER CENT IS EQUAL TO A 10 PER CENT DIFFERENCE BETWEEN, SAY, 10 PER CENT AND 20 PER CENT.

IT WOULD BE POSSIBLE TO EXPAND THE NUMBER OF COMPARISONS BY PIVOTING ON TWO VERSIONS BUT THE ADVANTAGES WOULD PROBABLY NOT BE WORTH THE EXTENSION OF THE ASSUMPTIONS AND INCREASE IN SIZE OF SAMPLING ERRORS. THERE ARE THEN SEVEN COMPARISONS OF VERSIONS I AND II:

I - II

(I - III) - (II - III')

(I - IV) - (II - IV')

(I - V) - (II - V')

(I - VI) - (II - VI')

(I - VII) - (II - VII')

(I -VIII) - (II -VIII')

A SIMILAR SET OF SEVEN COMPARISONS IS AVAILABLE FOR ALL OF THE 28 FILM PAIRINGS.

FOLLOWING THROUGH A SET OF SEVEN COMPARISONS FOR ANY GIVEN FILM PAIRING YIELDS SEVEN INDEPENDENT ESTIMATES OF THE PROBABILITY OF OBTAINING A DIFFERENCE AS LARGE AS THE ONE OBSERVED BETWEEN THE MEMBERS OF THE PAIR. WHILE THE ADVANTAGES OF REPLICATION ARE WELL KNOWN, METHODS FOR COMBINING THE INDEPENDENT VALUES ARE NOT. SINCE THE PROBABILITIES ARE NOT ADDITIVE, LINDQUIST (7, P. 46-47) SUGGESTS CONVERTING THEM INTO CHI SQUARE VALUES, WHICH ARE ADDITIVE. THE COMBINED PROBABILITY IS THE PROBABILITY FOR THE SUMMED CHI-SQUARES WITH, IN THIS CASE, FOURTEEN DEGREES OF FREEDOM.

THE STATISTICAL HYPOTHESIS

A RELEVANT HYPOTHESIS IN MOST INVESTIGATIONS IS THE NULL HYPOTHESIS. THIS HYPOTHESIS STATES THAT A TRUE DIFFERENCE OF SOME ORDER EXISTS, AND THAT DEVIATIONS FROM THIS TRUE DIFFERENCE CAN BE ACCOUNTED FOR BY CHANCE FLUCTUATIONS. THE SAMPLING STATISTICS, THE RESULTS OF WHICH ARE REPORTED IN THIS CHAPTER, ARE DIRECTED TOWARD FINDING WHETHER THE NULL HYPOTHESIS CAN BE REJECTED WITH CONFIDENCE. THROUGHOUT, IT IS ASSUMED THAT THE TRUE DIFFERENCE IS ZERO. FOR EACH OBSERVED DIFFERENCE ENTERED IN THE TABLES (FOR THE GROUPED-DATA

ANALYSIS) AND FOR EACH CHI-SQUARE VALUE (FOR THE RANDOM-HALF CONTROL ANALYSIS) AN INDICATION IS GIVEN OF THE PROBABILITY THAT A DIFFERENCE AS GREAT AS, OR GREATER THAN, THE OBTAINED DIFFERENCE WOULD BE FOUND WHEN THE TRUE STATISTIC IS ZERO, AND ONLY CHANCE FACTORS ARE OPERATING. WHEN THE PROBABILITY IS SMALL, THE NULL HYPOTHESIS MAY BE REJECTED, WITH A CERTAIN LEVEL OF CONFIDENCE, AND THE DIFFERENCES MAY BE ATTRIBUTED TO THE EXPERIMENTAL VARIABLES IF THE CONTROLS ARE ADEQUATE.

SINCE THE NULL HYPOTHESIS WILL HERE BE REJECTED ONLY WHEN THE DIFFERENCE IS IN A SPECIFIED DIRECTION, THE PROBABILITIES REPRESENT ONLY ONE TAIL OF THE CHANCE DISTRIBUTION.

WHILE THE GROUPED-DATA AND THE RANDOM-HALF CONTROL ANALYSES ARE LARGELY CONSISTENT, THERE IS SOME DISAGREEMENT. SINCE THE LATTER TECHNIQUE IS BASED ON BETTER SAMPLING ASSUMPTIONS, IT SHOULD CARRY GREATER WEIGHT. ALSO, IT SOMETIMES APPEARS THAT THE CHI-SQUARE TRANSFORMATION, AT LEAST AS USED HERE, UNDERESTIMATES THE PROBABILITY VALUE. IT SHOULD BE REMEMBERED THAT THIS TECHNIQUE IS MORE SENSITIVE IN THAT IT MAKES USE OF, IN EFFECT, SEVEN REPLICATIONS.

THESE DISCREPANCIES ARE CONSEQUENTIAL ONLY IF THEY LEAD TO IMPROPER INFERENCES. ASSUMING RATHER GROSS ERRORS, NONE OF THE INFERENCES IN THIS CHAPTER WOULD BE CHANGED, SAVE THAT THE STATEMENT ABOUT THE PARTICIPATION HYPOTHESIS WOULD BE FURTHER QUALIFIED.

FINDINGS

IT CAN BE REPORTED THAT "CONTROL" GROUPS WERE RUN AND THAT, OF 112 SUBJECTS, 7% COULD TIE THE BOWLINE, APPROXIMATELY 3% THE SHEET BEND, AND NONE THE SPANISH BOWLINE, WITHOUT HAVING BEEN GIVEN INSTRUCTION BY FILMS OR OTHERWISE. NO FURTHER CONSIDERATION WILL BE GIVEN TO FILM INSTRUCTION AS COMPARED WITH NO INSTRUCTION.

TABLE 3 GIVES THE PROPORTION OF RECRUITS WHO SUCCESSFULLY TIED EACH OF THE DIFFERENT KNOTS FOLLOWING EXCLUSIVE INSTRUCTION BY ONE OF THE EXPERIMENTAL FILM VERSIONS. ALSO, IN THE LAST COLUMN THE MEAN TOTAL SCORE FOR ALL THREE KNOTS FOR EACH VERSION IS GIVEN. THE LAST LINE SHOWS THE PROPORTION OF KNOTS TIED WITHOUT RESPECT TO FILM VERSION.

TABLE 3

NUMBER OF SUBJECTS, AND PROPORTION OF SUBJECTS SUCCESSFUL IN TYING KNOTS, FOR EACH FILM VERSION

Film Version	Number of Subjects	Bowline	Sheet Bend	Spanish Bowline	Mean Total Score
I(180-M-H-NP)	418	.256	.103	.110	.469
II(0-S-NH-NP)	428	.582	.103	.028	.713
III(0-S-H-NP)	417	.439	.082	.034	.554
IV(0-M-H-NP)	424	.542	.311	.255	1.108
V(180-M-H-P)	405	.254	.168	.042	.464
VI(0-S-NH-P)	397	.589	.123	.040	.753
VII(0-S-H-P)	409	.469	.073	.032	.575
VIII(0-M-H-P)	416	.587	.351	.255	1.192
All Versions	3314	.465	.165	.100	.730

Total score analysis. Comparisons among the total scores for the versions are presented in Table 4. These comparisons provided a test of the experimental hypothesis with reference to knot tying performance independent of task difficulty. Any interactions with difficulty which might be suggested by other analyses may be lost in the summation. In so far as any propositions bearing on this problem can be advanced, they will be discussed later.

1. Motion. The basic comparisons for this variable are films IV (O-M-H-NP) versus III (O-S-H-NP), and VIII (O-M-N-P) versus VII (O-S-H-P). All these films include HANDS, but III and VII are STATIC. The major difference is the movement. It can be stated with a very high level of confidence that the films protraying continuous changes through movement are the more effective films. It will soon be noted that the HANDS may act as a suppressor variable. If versions without HANDS are superior to versions with HANDS, the superiority of version IV and III is meaningless unless it (IV) is also superior to II (O-S-NH-NP). This obtains for both IV versus II, and VIII versus VI (O-S-NH-P). If the motion versions were not clearly superior to the STATIC-NO-HANDS versions, the results might be difficult to interpret. Fortunately, this is not the case.

It would seem that the experimental hypothesis is supported.

2. Hands. Comparison of static HAND versions III (O-S-H-NP) and VII (O-S-N-P) with the static NO-HAND versions II (O-S-NH-NP) and VII (O-S-NH-P) favors the films which DO NOT protray hands. While the inclusion of HANDS was not expected to be a LARGE step along the realism continuum, especially in view of the static portrayal, neither was it anticipated that this addition would weigh in the opposite direction. Two alternate hypotheses, which should be considered in further work to resolve this discrepancy, are suggested:

The inclusion of hands must, perforce, obscure some of the line, thus reducing the accuracy of the presentation of the object acted upon or the clearness of the significant perceptual fields. If the increased accuracy of representation of the performer is smaller than the decrease in the representation of the object, the resultant is not in the desired direction. It would be necessary to find some technique for weighting these factors.

Inspection of the films themselves leads to a second consideration. Dissolves were used between stages of tying the knots. It may be that dissolves in the versions WITHOUT HANDS may have conveyed transitional relationships between stages, while, when hands were shown during the dissolves, the composition of the pictures became crowded and confused. Relationships could not be clearly perceived.

TABLE 4

TOTAL SCORE: DIFFERENCE BY GROUPED-DATA ANALYSIS IN MEAN NUMBER OF KNOTS TIED CORRECTLY, AND CHI-SQUARE VALUES (IN PARENTHESES) FOR RANDOM-HALF CONTROL ANALYSIS

Film Version	Film Version I	II	III	IV	V	VI	VII	VIII
I		-.244* (-41*)	-.085	-.640* (-120*)		-.284* (-39*)	-.106*	-.723* (-155*)
II			.159* (43*)	-.396* (-73*)	.248* (50*)		.138* (34*)	-.480* (-94*)
III				-.554* (-120*)	.090	-.199* (-36*)		-.638* (-150*)
IV					.644* (124*)	.355* (68*)	.534* (116*)	(-26)
V						-.289* (-34*)	-.110*	-.728* (-157*)
VI							.179* (34*)	-.439* (-89*)
VII								-.618* (-145*)
VIII								

Sign from higher code number minus lower.

* Indicates 1 chance (or less) in 100 of getting differences as large or larger in the hypothesized direction if the true difference were 0 and only chance factors were operating.

Absence of the asterisk indicates 5 chances (or less, but more than 1) in 100. Values are not entered where the chances are greater than 5 in 100.

It might also be pointed out, as will be discussed later, that the major contribution to these findings is made by the bowline. The first point discussed immediately above may be particularly pertinent for this knot.

3. Camera Angle. The superiority of the 0 degree camera angle is unequivocal. Both versions IV (0-M-H-NP) and VII (0-M-H-P) are obviously superior to their counterparts, versions I (180-M-H-NP) and V (180-M-H-P).

4. Participation. When the first three versions are compared with the corresponding participation presentations, the differences found are best explained in terms of chance. Version VIII, however, can be said to be better than version IV with a moderate degree of confidence.

The equivocal nature of this outcome may be attributed to the fact that participation as defined was not actually achieved. While all subjects attempted to "participate", a proportion never succeeded in tying knots during the film showing. It may be seen in Table 5 that only a few more knots were tied during participation in the film viewing than during the test period. Also, the order of the number of knots tied during practice follows the order of effectiveness of the respective non-participation versions rather closely and the difficulty of the task inversely. It would seem, then, that in order to study this variable more closely films must be so produced as to make participation possible; that this is more difficult for complicated tasks, and that as this objective is approached the contribution of participation may be realized.

5. Over-all order of the versions. Although some of the positions in the hierarchy are not reliably determined, the several versions may be ranked in the following order of effectiveness with respect to total score: VIII, IV, II, VI, VII, I, III, and V. This is in agreement with the hierarchies predicted, except for the inversion of the hands and no-hands static versions.

Analysis by individual knots. With the exception of the placement of versions II (0-S-NH-NP) and VI (0-S-NH-P) high in order of effectiveness for the other two knots, the findings for the individual knots are essentially consistent with one another and with the findings for the total scores. The differences among the versions in proportions succeeding in tying each knot are given in Tables 6 (bowline), 7 (sheet bend), and 8 (Spanish bowline).

It should be recalled that the comparisons based on individual knots are not as sensitive as those based upon the total score. The lack of refutation of the null hypothesis in these comparisons should therefore not be considered as refutations of the experimental hypotheses. Further, it is futile to discuss sign reversals in cases where the null hypothesis is not rejected, for the possibility of differences in

TABLE 5

NUMBER OF PRACTICE AND TEST KNOTS TIED FOR PARTICIPATION FILM VERSIONS

Film	N	Bowline		Sheet Bend		Spanish Bowline		All knots	
		Part.	Test	Part.	Test	Part.	Test	Part.	Test
V	405	93	103	75	68	20	17	188	188
VI	397	261	234	76	49	24	16	361	299
VII	409	214	192	31	30	8	13	253	235
VIII	416	300	244	284	146	225	106	809	496
Total	1627	868	773	466	293	277	152	1611	1218

TABLE 6

BOWLINE: DIFFERENCES BY GROUPED-DATA ANALYSIS IN PROPORTIONS OF KNOTS TIED CORRECTLY, AND CHI-SQUARE VALUES (IN PARENTHESES) FOR RANDOM-HALF CONTROL ANALYSIS

Film Version	Film Version I	II	III	IV	V	VI	VII	VIII
I		-.326* (-93*)	-.183* (-37*)	-.286* (-60*)		-.333* (-83*)	-.213* (-41*)	-.331* (-101*)
II			.143* (46*)	(29)	.327* (108*)		.112* (45*)	
III				-.104* (-31*)	.185* (40*)	-.151* (-39*)	(-36*)	-.148* (-48*)
IV					.288* (66*)		.073 (73*)	(-27)
V						-.335* (-90*)	-.215* (-44*)	-.332* (-109*)
VI							.120* (39*)	
VII								-.117* (-49*)
VIII								

Sign from higher code number minus lower.

* Indicates 1 chance (or less) in 100 of getting differences as large or larger in the hypothesized direction if the true difference were 0 and only chance factors were operating.

Absence of the asterisk indicates 5 chances (or less, but more than 1) in 100. Values are not entered where the chances are greater than 5 in 100.

TABLE 7

SHEET BEND: DIFFERENCES BY GROUPED-DATA ANALYSIS IN PROPORTIONS OF KNOTS TIED CORRECTLY, AND CHI-SQUARE VALUES (IN PARENTHESES) FOR RANDOM-HALF CONTROL ANALYSIS.

Film Version	FILM VERSION I	II	III	IV	V	VI	VII	VIII
I				-.208* (-78*)	-.065* (-41*)			-.248* (-102*)
II				-.209* (-82*)	-.065* (-41*)			-.248* (-98*)
III				-.230* (-98*)	-.086* (-48*)	-.042		-.269* (-124*)
IV					.143* (44*)	.188* (79*)	.238* (85*)	
V						.044 (38*)	.095* (40*)	-.183* (-57*)
VI							.050	-.228* (-94*)
VII								-.278* (-102*)
VIII								

Sign from higher code number minus lower.

* Indicates 1 chance (or less) in 100 of getting differences as large or larger in the hypothesized direction if the true difference were 0 and only chance factors were operating.

Absence of the Asterisk indicates 5 chances (or less, but more than 1) in 100. Values are not entered where the chances are greater than 5 in 100.

TABLE 8

SPANISH BOWLINE: DIFFERENCES BY GROUPED-DATA ANALYSIS IN PROPORTIONS OF KNOTS TIED CORRECTLY, AND CHI-SQUARE VALUES (IN PARENTHESES) FOR RANDOM-HALF CONTROL ANALYSIS

Film Version	Film Version I	II	III	IV	V	VI	VII	VIII
I		.082* (33*)	.076* (39*)	-.145* (-62*)	.068* (31*)	.070* (36*)	.078* (40*)	-.145* (-54*)
II				-.227* (-111*)				-.227* (-113*)
III				-.221* (-120*)	(-25)			-.221* (-109*)
IV					.213* (100*)	.214* (120*)	.223* (121*)	
V							(94*)	-.213* (-96*)
VI								-.215* (-110*)
VII								-.223* (-113*)
VIII								

Sign from higher code number minus lower.

* Indicates 1 chance (or less) in 100 of getting differences as large or larger in the hypothesized direction if the true difference were 0 and only chance factors were operating.

Absence of the asterisk indicates 5 chances (or less, but more than 1) in 100. Values are not entered where the chances are greater than 5 in 100.

EITHER DIRECTION IS PREDICTED BY THIS HYPOTHESIS.

THE RANK ORDER OF THE FILMS FOR THE THREE KNOTS, STATED WITH MUCH LESS CONFIDENCE THAN FOR TOTAL SCORE, IS AS FOLLOWS:

BOWLINE VIII, II, IV, VI, VII, III, V, I

SHEET BEND VIII, IV, V, I, VI, VII, II, III

SPANISH BOWLINE IV, VIII, I, V, VI, II, VII, III

FILM II, THE STATIC NO-HANDS VERSION, IS PARTICULARLY EFFECTIVE IN TEACHING THE TYING OF THE BOLINE. THIS WAS NOT TRUE FOR THE OTHER TWO KNOTS. IT MAY WELL BE THAT IN THIS VERSION THE PHOTOGRAPHY FOR THE THREE KNOTS WAS NOT EQUALLY CLEAR.

TWO OTHER POSSIBLE EXPLANATIONS SEEM MORE REASONABLE. IT MAY BE THAT FOR A SIMPLE TASK IT IS ONLY NECESSARY TO PRESENT A GOOD PICTURE OF THE THING ACTED UPON AND THE LEARNER CAN READILY SUPPLY THE NECESSARY MOVEMENTS FROM HIS REPERTOIRE.[4]

IF THE SUBJECTS WERE INSTRUCTED TO DRAW A +, ANY NUMBER OF POSSIBLE PRESENTATIONS WOULD BE EQUALLY EFFECTIVE. IT IS DOUBTFUL THAT SHOWING THE NECESSARY PENCIL MOVEMENTS OR THE DEVELOPMENT OF THE + WOULD CONTRIBUTE ANYTHING. A SLIGHTLY MORE COMPLICATED CROSS, SAY ✝, MIGHT REQUIRE BETTER PRESENTATION, BUT AGAIN, THE MAIN CONSIDERATION WOULD PROBABLY BE THE CLARIRY OF THE CROSS ITSELF. VERSION II SHOWED THE KNOTS WITHOUT ANY SUPERFLUOUS OR OBSCURING DETAIL.

AN ALTERNATE, OR ADDITIONAL, HYPOTHESIS MIGHT BE THAT, GIVEN A SIMPLE TASK AND AMPLE TIME, THE SUBJECT COULD SEARCH HIS RESPONSE REPERTOIRE TO FIND THE PROPER MOVEMENTS IF HE HAD A CLEAR PERCEPT. THE TIME LIMIT USED WAS TWO MINUTES. THIS IS MORE THAN ENOUGH TIME TO TIE THE BOWLINE MORE THAN ONCE. IF THE TIME LIMIT WERE REDUCED, LESS "SEARCHING TIME" WOULD BE AVAILABLE AND THE MOVEMENTS LEARNED FROM THE FILM SHOULD BE MORE EVIDENT.

COMPARISON OF BOWLINE VERSIONS II AND IV WERE REPEATED FOR TWO COMPANIES WITH A TIME LIMIT OF 75 SECONDS. THE CHANGE IN FAVOR OF FILM IV WAS INCONCLUSIVE, BUT BOTH OF THE ABOVE HYPOTHESES ARE SUPPORTED BY THE APPARENT GREATER IMPORTANCE OF

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[4] THE AVAILABILITY OF A REPERTOIRE OF MOVEMENTS IS IRRELEVANT UNLESS IT IS ASSUMED THAT THE STIMULI PRESENTED EVOKE THE DESIRED MOVEMENTS SPECIFICALLY, OR IT IS ASSUMED THAT ONLY THE END-PRODUCT IS OF INTEREST. IF THESE ASSUMPTIONS ARE UNTENABLE, THE QUESTION OF ATTENUATION DUE TO SCORING ONLY THE RESULTANT MUST AGAIN BE RAISED.

THE MOTION VARIABLE WITH INCREASE IN DIFFICULTY OF THE TASK. THE DIFFERENCES BETWEEN THE SEVERAL STATIC VERSIONS AND VERSIONS IV AND VIII TEND TO INCREASE WITH TASK DIFFICULTY. ALSO, VERSIONS I (180-M-H-NP) AND V (180-M-H-P) RANK RELATIVELY HIGHER FOR THE MORE DIFFICULT KNOTS IN SPITE OF THE OBVIOUS INFERIORITY OF THE 180 DEGREE CAMERA ANGLE.

IV CONCLUSIONS AND RECOMMENDATIONS

Conclusions

ON THE BASIS OF THE DATA IT IS JUSTIFIABLE TO CONCLUDE THAT THE MAJOR HYPOTHESIS THAT "THE LEARNING OF A PERCEPTUAL-MOTOR ACT, THROUGH FILMS, WILL BE MORE EFFECTIVE AS THE FILM APPROACHES A REPRESENTATION OF THE LEARNER HIMSELF PERFORMING THE ACT TO BE LEARNED", IS IN GENERAL SUSTAINED.

FOLLOWING, IN THE ORDER OF THE LEVEL OF CONFIDENCE WITH WHICH THEY MAY BE STATED, ARE THE SPECIFIC CONCLUSIONS FROM THIS EXPERIMENT:

1. CAMERA ANGLE. A TRAINING FILM DESIGNED TO TEACH A PERCEPTUAL-MOTOR TASK WILL BE MORE EFFECTIVE WHEN THE TASK IS PORTRAYED FROM A POINT OF VIEW AS NEAR AS POSSIBLE TO THAT OF THE LEARNER AS HE WILL ACTUALLY PERFORM THE TASK. IN OTHER WORDS, THE SUBJECTIVE OR 0 DEGREE CAMERA ANGLE IS MORE EFFECTIVE THAN THE OBSERVER OR 180 DEGREE CAMERA ANGLE.

2. MOTION. A TRAINING FILM DESIGNED TO TEACH A PERCEPTUAL-MOTOR TASK WILL BE MORE EFFECTIVE WHEN IT SHOWS ALL THE MOVEMENTS INVOLVED IN PERFORMING THE TASK, THAN WHEN IT SHOWS MERELY A SERIES OF STATIC SHOTS PORTRAYING SUCCESSIVE STAGES OF THE TASK.

3. PARTICIPATION. ALTHOUGH THE RESULTS DO NOT SHOW SIGNIFICANT ADVANTAGES FOR PARTICIPATION, THIS MAY HAVE BEEN DUE TO THE WAY THE FILM SITUATION WAS ORGANIZED. THERE IS AT LEAST SOME EVIDENCE TO SUGGEST THAT HAVING TRAINEES PRACTICE THE TASK WHILE VIEWING THE FILM MAY FACILITATE LEARNING.

4. HANDS. NO DEFINITE CONCLUSION CAN BE STATED CONCERNING THIS PARTICULAR VARIABLE, EXCEPT TO SAY THAT IF THE HANDS OF THE PERFORMER ARE INCLUDED IN THE PICTURES, CARE SHOULD BE TAKEN TO ENSURE THAT THEY DO NOT OBSCURE ANY IMPORTANT MOVEMENT IN PERFORMING THE TASK.

Recommendations

1. PRODUCERS OF TRAINING FILMS FOR TEACHING PERCEPTUAL-MOTOR TASKS SHOULD, WHEREVER POSSIBLE, USE THE SUBJECTIVE OR 0 DEGREE CAMERA ANGLE, IN ORDER TO PRESENT THE TASK FROM

THE LEARNER'S POINT OF VIEWING.

2. A TASK INVOLVING CONTINUOUS MOVEMENT SHOULD BE PRESENTED IN A FILM, IN WHICH THESE MOTIONS ARE CLEARLY SHOWN, RATHER THAN IN A SERIES OF STATIC PICTURES. IT IS SUGGESTED THEREFORE, THAT IN TEACHING TASKS SUCH AS THE ONE UNDER CONSIDERATION HERE, THE FILM STRIP OR FILMOGRAPH ARE PROBABLY NOT AS APPROPRIATE AS THE MOTION PICTURE.

3. SINCE IT HAS NOT BEEN CLEARLY DEMONSTRATED THAT PARTICIPATION BY MEANS OF PRACTICING THE TASK WHILE WATCHING THE FILM FACILITATES LEARNING, IT WOULD BE PREMATURE TO URGE AT THIS POINT THAT FILMS BE PRODUCED SO AS TO ALLOW CONCURRENT OVERT PRACTICE BY THE LEARNER. HOWEVER, THE EVIDENCE AVAILABLE SUGGESTS THAT FURTHER STUDIES OF THIS PROBLEM MIGHT VERY PROFITABLY BE UNDERTAKEN.

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A P P E N D I X

DESCRIPTION OF THE FILM

SCRIPT CONTENT	I. (180-M-H-NP)	II. (O-S-NH-NP)
1. Contract N6onr - 269 Task VII Office of Naval Research Special Devices Center TEST FILM No. _____ Instructional Film Research Program The Pennsylvania State College	Silent Title	Silent Title
2. This film will show you how to tie a knot. After the film, you will be asked to tie it.	Sound and Silent title	Sound and Silent title
3. This film will show you how to tie a knot. Using the practice line, tie the knot yourself as you see it being tied on the screen.	X	X
4. Follow through with each movement. When the knot on the screen is finished, yours should be finished too. After the film, you will be asked to tie the knot again in another line.	X	X
5. Tying a BOWLINE	Silent Title	Silent Title
6. To tie a bowline, start about two or three feet from the end of the line. Form a small loop. Pass end of the line through this loop, forming a larger loop below. Pass this same end around the long end. Then pass it through the small loop again so that it lies along side itself. Hold these two parts, and pull the long part until the knot is tight.	180° Camera Angle, Motion, Hands. Shows knot being tied from observer's view. 44 seconds	0° Camera angle, Static, No Hands. Shows 7 stages in tying of the knot. Dissolves between stages. 42 seconds.
7. B l a n k film	3 feet	3 feet
8. Repeat 2 (above)	Repeat 2	Repeat 2
9. Repeat 4 (above)	X	X
10. Tying a SHEET BEND	Silent Title	Silent Title

VERSIONS

FILM CONTENT					
III. (O-S-H-NP)	IV. (O-M-H-NP)	V. (180-M-H-P)	VI. (O-S-NH-P)	VII. (O-S-H-P)	VIII. (O-M-H-P)
Silent Title	Silent Title	Silent Title	Silent Title	Silent Title	Silent Title
Sound and Silent title	Sound and Silent title	X	X	X	X
X	X	Sound and Silent title	Sound and Silent title	Sound and Silent title	Sound and Silent title
X	X	Sound and Silent title	Sound and Silent title	Sound and Silent title	Sound and Silent title
Silent Title	Silent Title	Silent Title	Silent Title	Silent Title	Silent Title
0° Camera angle, Static, Hands. Shows 7 stages in the tying of the knot with hands in position. Dissolves between stages 42 seconds.	0° Camera angle, Motion, Hands. Shows knot being tied from subject's own point of view. 42 seconds.	Same as I	Same as II	Same as III	Same as IV
3 feet	3 feet	3 feet	3 feet	3 feet	3 feet
Repeat 2	Repeat 2	X	X	X	X
X	X	Repeat 4	Repeat 4	Repeat 4	Repeat 4
Silent title	Silent title	Silent title	Silent title	Silent title	Silent title

		I.	II.
11.	The sheet bend is used to join two lines. Cross the lines and hold them. Take the long part and loop it around its own end so that it crosses between the two short ends. Take the short end of the line which is not looped, bring it around and through the loop; place it along-side its own long part. Take the long part of the other line and pull the loops tight.	180° Camera Angle, Motion, Hands. Shows knot being tied from observer's view. 42 seconds	0° Camera Angle, Static, No hands. Shows 5 stages in the tying of the knot. Dissolves between stages. 41 seconds
12.	Blank film	3 feet	3 feet
13.	Repeat 2 (previous page)	Repeat 2	Repeat 2
14.	Repeat 4 (previous page)	X	X
15.	Tying a SPANISH BOWLINE	Silent Title	Silent Title
16.	To tie the Spanish bowline, form a small loop. Bring a large loop around the small loop. Form another small loop inside the large loop. Grasp the center of the large loop and bring it up close to the two small loops forming two fairly large loops. Put one of the larger loops through the small loop near it. In the same way, put the other large loop through the small loop near it. Grasp these two loops and the ends of the line and pull tight.	180° Camera Angle, Motion, Hands. Shows knot being tied from observer's view. 63 seconds.	0° Camera Angle, Static, No hands. Shows 9 stages in the tying of the knot. Dissolves between stages. 63 seconds.

RECAPITULATION:

Camera angle	(180° or 0°)	180	0
Motion	(or Static)	M	S
Hands	(or No Hands)	H	NH
Participation	(or No Participation)	NP	NP

III.	IV.	V.	VI.	VII.	VIII.
0° Camera Angle, Static, Hands. Shows 5 Stages in the tying of the knot with hands in position. Dissolves between stages. 41 seconds.	0° Camera Angle, Motion, Hands. Shows knot being tied from subject's point of view. 41 seconds.	Same as I	Same as II	Same as III	Same as IV
3 feet	3 feet	3 feet	3 feet	3 feet	3 feet
Repeat 2	Repeat 2	X	X	X	X
X	X	Repeat 4	Repeat 4	Repeat 4	Repeat 4
Silent Title	Silent Title	Silent Title	Silent Title	Silent Title	Silent Title
0° Camera Angle, Static, Hands. Shows 8 stages in tying of the knot with hands in position. Dissolves between stages. 63 seconds.	0° Camera Angle, Motion, Hands. Shows knot being tied from subject's own point of view. 63 seconds.	Same as I	Same as II	Same as III	Same as IV
O	O	180	O	O	O
S	M	M	S	S	M
H	H	H	NH	H	H
NP	NP	P	P	P	P